

CLAIMS

What is claimed is:

1. In a portion of a wire bonding machine apparatus having a support for a semiconductor device and having a capillary used for bonding a wire to a portion of a semiconductor die and a portion of a lead frame comprising:
a block for heating and for supporting a semiconductor device during a wire bonding operation;
a wire bonding capillary tool having an outer diameter including:
a capillary tip having a hole therethrough terminating at one end of the capillary tip; and
a face on the one end of the capillary tip, the face including a first frusto-conical surface extending from a portion of the elongated hole of the capillary tip, a second frusto-conical surface having a portion thereof connected to the first frusto-conical surface, a substantially horizontal annular surface having a portion connected to the second frusto-conical surface, the substantially horizontal annular surface defined by a radius of curvature of the capillary tip, the substantially horizontal annular surface is formed by a radius having a concave surface with a degree of curvature, the concave surface extending from a portion of the substantially horizontal annular surface, the degree of curvature of the concave surface defined by a radius of curvature and the degree of curvature of the concave surface providing clearance of the capillary tip from portions of the semiconductor device, and an annular curved surface intersecting the concave surface extending from the substantially horizontal annular surface, and an annular conical surface extending from an outer diameter of the face of the capillary tip.
2. The portion of claim 1, wherein the substantially horizontal annular surface intersects the outer diameter of the capillary tip of the wire bonding capillary tool.

3. A method of forming a connection between a bond pad of a semiconductor device having an active surface thereon having at least one bond pad thereon and a portion of a lead frame, said method comprising:

providing a wire bonding capillary including:

- a capillary tip having an elongated hole therethrough, the elongated hole terminating at one end of the capillary tip; and
- a face on the one end of the capillary tip, the face including a first frusto-conical surface extending from a portion of the elongated hole of the capillary tip, a second frusto-conical surface having a portion thereof connected to the first frusto-conical surface, a substantially horizontal annular surface having a portion thereof connected to the second frusto-conical surface, a concave surface having a portion extending from the substantially horizontal annular surface, and an annular curved surface intersecting the concave surface;

extending a wire through the elongated hole in the capillary tip;

heating a portion of the wire to form a mass on an end thereof;

contacting the at least one bond pad on the active surface of the semiconductor device with the mass on the end of the wire;

securing the mass on the end of the wire to the at least one bond pad on the active surface of the semiconductor device;

forming a wire bond to the at least one bond pad having a substantially horizontal annular surface on a portion of the wire bond, the substantially horizontal annular surface is formed by a radius, the wire bond having no contact with the active surface of the semiconductor device, the mass on the end of the wire used to form the wire bond including a first frusto-conical portion adjacent the wire, a second frusto-conical portion connected to the first frusto-conical portion, and a substantially horizontal annular portion connected to the second frusto-conical portion;

feeding a portion of wire through the opening in the capillary; and

forming a wire bond on a portion of the lead frame.

4. A method of forming a wire bond on a lead finger of a lead frame comprising:
providing a wire bonding capillary including:
a capillary tip having an elongated hole therethrough, the elongated hole terminating at one end
of the capillary tip;
a face on an end of the capillary tip, the face including a first frusto-conical surface
extending from a portion of the elongated hole of the capillary tip, a second
frusto-conical surface having a portion thereof connected to the first frusto-conical
surface, a substantially horizontal annular surface having a portion connected to
the second frusto-conical surface, the substantially horizontal annular curved
surface is formed by a radius having a concave surface extending from the
substantially horizontal annular surface, and an annular curved surface
intersecting the concave surface;
extending a portion of a wire through the elongated hole in the capillary tip;
heating a portion of the wire;
contacting a portion of the lead finger of the lead frame with the heated portion of the wire;
attaching a portion of the heated portion of the wire to the portion of the lead finger forming a
wire bond thereon having a curved convex surface on a portion thereof formed by at least
a portion of the concave surface of the face of the capillary tip; and
severing the wire using a portion of the capillary.